

A Taxonomic revision of *Aleurites* J.R. Forst. & G.Forst. (Euphorbiaceae) in Australia and New Guinea

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ABSTRACT

The genus *Aleurites* J.R.Forst. & G.Forst. is revised for Australia and New Guinea, and includes two species *Aleurites moluccana* (L.) Willd. and *A. rockinghamensis* (Baill.) P.I.Forst. *comb. et stat. nov.* Both species are illustrated and notes on distribution, habitat, typification and conservation status are provided. A lectotype is selected for the name *A. moluccana* var. *rockinghamensis* Baill.

Introduction

The genus *Aleurites* was described by J.R. & G. Forster (1776). It included the single species *A. triloba*, based on a collection that they had made at Tonga in the Pacific Ocean while naturalists on James Cook's third voyage of discovery. The same species had been previously described under *Jatropha* as *J. moluccana* L. (Linnaeus 1753) and this earlier name was subsequently transferred to *Aleurites* by Willdenow (1805).

Aleurites has a wide distribution in Asia, Malesia, Melanesia and Australia, with one species *A. moluccana* widespread and common throughout the entire range (Airy Shaw 1980, 1981; Smith 1981; Wagner *et al.* 1990). The genus was included by Webster (1994) in Euphorbiaceae subfamily Crotonoidae, tribe Aleuritideae Hurusawa, Subtribe Aleuritinae (Hurusawa) Webster, together with *Vernicia* Lour. and *Reutealis* Airy Shaw.

At times *Aleurites* has had up to six species included in it (e.g. Mueller 1866; Webster 1967; Wagner *et al.* 1990); however, several of these, including the Chinese Tung-Oil Tree (formerly *A. fordii* Hemsl.) are better placed in *Vernicia* (e.g. Radcliffe-Smith 1987). Authors of recent accounts of *Aleurites* have indicated that only a single species *A. moluccana* exists with two or three varieties (Airy Shaw 1981), although Radcliffe-Smith (1987) considered the genus to comprise two species. *Aleurites moluccana* has been considered a polymorphic species by several authors with *A. moluccana* var. *moluccana* being widespread throughout the species range; *A. moluccana* var. *rockinghamensis* Baill. being endemic to Australia (Baillon 1866), *A. moluccana* var. *floccosa* Airy Shaw endemic to New Guinea (Airy Shaw 1966) and several varieties endemic to Hawaii (Sherff 1951; Stonc 1967; Degener & Degener 1971). These Hawaiian varieties are no longer recognised (Wagner *et al.* 1990).

There is also the problem of *A. erratica* Deg., I. Deg. & Hummel. *Aleurites erratica* was named on the basis of drift seed collected at Canton Atoll in the Pacific by the Degeners who distinguished it from *A. moluccana* on surface patterning (Degener *et al.* 1978). The name *A. erratica* has been applied to drift seed on an atoll on the north-east Australian coast (Smith 1994), but not to any naturally occurring populations in Australia and New Guinea. Although *A. erratica* is probably a synonym of *A. moluccana*, some critical attention is required to determine why the different seed patterning occurs, before it is dismissed out of hand.

In the present paper I have restricted the geographical coverage to populations of *Aleurites* that occur naturally in Australia and New Guinea. Most of the range outside this area has only *A. moluccana* s.s. present, and there is little need to review the available material yet again.

Thus, this leaves the question of the two or three varieties of *A. moluccana* in Australia and New Guinea (Airy Shaw 1980, 1981). *Aleurites* was first recorded for Australia by Mueller (1865), who thought that the Australian species was *A. triloba*. Shortly after, Baillon (1866) described *A. moluccana* var. *rockinghamensis* from material collected by Dallachy in north Queensland, although only *A. moluccana* was recognised by Bentham (1873) and Bailey (1902). In New Guinea, the first record of *Aleurites* was for *A. moluccana* (Smith 1910), with *A. moluccana* var. *floccosa* described from the Bulolo Valley by Airy Shaw (1966).

In his final contribution on the genus, Airy Shaw (1981) enumerated two varieties for Australia, *A. moluccana* var. *moluccana* and *A. moluccana* var. *rockinghamensis* and placed *A. moluccana* var. *floccosa* from New Guinea, with a question mark, in the synonymy of *A. moluccana* var. *rockinghamensis*. He distinguished the two varieties with:

‘var. **moluccana** . . . Indumentum thin, evanescent; leaves relatively narrow, not or rarely cordate; ovary and fruit bilocular . . .

var. **rockinghamensis** . . . Indumentum evident, subfloccose; leaves broader, mostly cordate; ovary and fruit 3(-4)-locular.’

Aleurites moluccana s.s. and *A. moluccana* var. *rockinghamensis* are largely allopatric throughout their known range with the former growing in more xeromorphic rainforest/vineforest communities than the latter. There are several known examples of sympatry, namely at the base of Big Tableland (G. Sankowsky *pers. comm.* 1992) and just north of the Bloomfield River at Wujal Wujal (*pers. obs.* 1994). No intermediate individuals have been observed at these localities. In addition to the differences outlined by Airy Shaw (1981), there are also discontinuities in floral and seedling morphology. Given the distribution of the two taxa, the lack of intermediates and the many morphological discontinuities, *A. moluccana* var. *rockinghamensis* is elevated to species status in this paper.

Materials and methods

This revision is based on herbarium holdings at AD, BRI, CANB, CBG, DNA, MEL, NSW and QRS and field observations and collections by the author in Australia and New Guinea.

Floral descriptions were prepared from material preserved in spirit (FAA or 70% alcohol and glycerol) or reconstituted by boiling in water and detergent. Fruit and seed descriptions were prepared from material preserved in spirit or dried. Foliage and inflorescence descriptions were prepared from dried material. Indumentum cover is described using the terminology of Hewson (1988), except that ‘scattered’ is used instead of ‘isolated’.

The ‘Wet Tropics’ is defined as the area of north-eastern Queensland that encompasses the ‘hot, humid, vine forests’ from near Cooktown in the north to Paluma in the south (Webb & Tracey 1981; Barlow & Hyland 1988). Rainforest terminology follows Webb (1978).

Taxonomy

Aleurites J.R.Forst. & G.Forst., *Char. Gen. Pl.* 111 (1776). TYPE: *Aleurites moluccana* (L.) Willd.

Derivation of name: from the Greek for ‘wheaten flour’, alluding to the mealy appearance of the lower leaf surface.

Trees. monoecious, evergreen, perennial; stems and foliage without obvious latex. *Indumentum* of simple or stellate, multicellular trichomes, not glandular, stinging hairs absent. *Stipules* entire, inconspicuous, deciduous. *Leaves* alternate, petiolate, palmnerved, lobate, entire, with 2 glands at base of lamina. *Inflorescences* terminal, paniculate, solitary, uni- or bisexual with the flowers in bracteate clusters. *Bisexual*

inflorescences with a solitary female flower terminating each major axis, lateral cymules male. *Female flowers*: short pedicellate; calyx closed in bud, rupturing into 2 or 3 lobes; petals 5(6), free, imbricate, disc 5-lobed; ovary 2-4-locular, ovules uniloculate; styles 2 or 3, fused at base, bilobed. *Male flowers*: long pedicellate; calyx closed in bud, rupturing into 2 or 3 lobes; petals 5(6), free, imbricate, disk 5-lobed; stamens 4-verticillate, numerous, the outer ones free, the inner ones \pm united and borne on a conical receptacle, anthers dorsifixed, introrse and bilobate, thecae oblong and longitudinally dehiscent; pistillodes absent. *Fruits* drupaceous, indehiscent; exocarp fleshy; endocarp woody, 1-4-locular. *Seeds* ovoid to globose; testa woody; albumen hard; ecarunculate; germination epigeal; cotyledons broad, flat.

A genus of two (or perhaps three) species in tropical Asia, Malesia, Melanesia and Australia. Two species in Australia and New Guinea.

KEY TO THE SPECIES OF *ALEURITES* IN AUSTRALIA AND NEW GUINEA

- 1 Indumentum silver; lower leaf surface glabrous or with scattered trichomes; flowers 5-8 mm long; stamens 18-26; styles 0.5-2 mm long; ovary and fruit 1-2(-3)-locular **1. *Aleurites moluccana***
 1: Indumentum ferruginous-silver; lower leaf surface with sparse to dense, generally velutinous trichomes; flowers 8-12 mm long; stamens 24-32; styles 2.8-3 mm long; ovary and fruit 3-4-locular **2. *Aleurites rockinghamensis***

1. *Aleurites moluccana* (L.) Willd., *Sp. Pl.* 4: 590 (1805). *Jatropha moluccana* L., *Sp. Pl.* 1006 (1753). TYPE: Ceylon, *Hermann Herbarium* Vol. III, p. 27 (LECTOTYPE: *vide Radcliffe-Smith* (1987: 176): BM [photo at BRI]). *Aleurites triloba* Forst. & G. Forst. *Char. Gen. Pl.* 112, t. 56 (1776). TYPE: Tonga, *Forster 214.360* (HOLOTYPE: BM [photo at BRI]).

Illustrations: Christophel & Hyland (1993: 96, plate 34d); Radke *et al.* (1993: 16).

Large spreading tree to 30 m high; trunk straight and without fluting or buttressing. *Bark* smooth, grey, nondescript; blaze pink to red. *Young shoots* with dense, short, silver, stellate hairs. *Stipules* cylindrical, c. 1 mm long, with dense short, silver, stellate hairs. *Petioles* 35-110 mm long, 1-1.5 mm diameter, with dense, short, silver stellate hairs. *Leaf laminae* entire or 3 or 5-lobed, ovate, ovate-lanceolate or ovate-trullate, 70-200 mm long, 40-130 mm wide, 3 or 5-veined from base and with 6-8 major lateral veins per side of midrib; upper surface dull green, glabrous or with scattered silver stellate hairs when young; lower surface pale green, glabrous or with scattered, silver, stellate hairs when young; apex acute to acuminate; base cuneate. *Inflorescence* conical, 30-100 mm long and wide; axis with dense, short, silver, stellate hairs. *Male flowers* 5-6 mm long, c. 5 mm diameter; pedicels filiform, 5.5-8 mm long, 0.3-0.5 mm diameter, with dense, short, silver, stellate hairs; buds ovoid, 2.5-3 mm long, 2-2.5 mm diameter; calyx 2 or rarely 3-parted, halves often unequal, lanceolate to ovate, 2.5-3 mm long, 1.5-2 mm wide, with dense, short, silver, stellate hairs; petals oblanceolate to spatulate, 4-6 mm long, 1.5-3 mm wide, white to cream, glabrous; stamens 18-26; filaments 0.8-1.5 mm long, with sparse simple hairs; anthers 0.6-0.8 mm long, 0.3-0.6 mm wide, glabrous or with scattered, simple hairs; disc lobes convolute. *Female flowers* 7-8 mm long, 8-10 mm diameter; pedicels stout, 2-3.5 mm long, 1-2 mm diameter, with dense, short, silver, stellate hairs; buds ellipsoid, 4-5 mm long, c. 2 mm diameter; calyx with 2 or 3 unequal lobes, each lobe 3-3.5 mm long, 1.5-2 mm wide, lanceolate to ovate, with dense, short, silver, stellate hairs; petals oblanceolate to spatulate, 6-8 mm long, 1.8-2 mm wide, white to cream, internally glabrous, externally glabrous or with a few simple hairs in a longitudinal band in the middle; ovaries 1-2-celled, subglobose, 2-3 mm long, 2-4 mm diameter, with dense, yellow, stellate hairs; styles 0.5-2 mm long, \pm glabrous or with a few simple hairs; disc glands small and rounded. *Fruit* ovoid-subglobose, 40-45 mm long, 40-60 mm diameter, with scattered silver, stellate hairs. *Seed* broadly ovoid, 23-32 mm long, 20-32 mm diameter, greyish. *Seedlings* at third leaf stage (voucher: *Hyland RFK25545*): cotyledons broadly ovate-obovate, 18-22 mm long, 18-20 mm wide, strongly 5-veined from base, glands

not obvious; first seedling leaf trilobed with the median lobe long-acuminate; later leaves becoming 5-lobed. (Fig. 1)

DISTRIBUTION AND CONSERVATION STATUS

Aleurites moluccana is widespread in Malesia and Melanesia, and often planted in other tropical areas. In Australia *A. moluccana* is restricted to north Queensland where it is common on Cape York Peninsula and in the northern part of the 'Wet Tropics' region reaching a southern limit on the Windsor Tableland. There is also a southerly disjunct population at Daydream Island. In New Guinea, *A. moluccana* is found in lowland areas, and is widespread on the island.

Aleurites moluccana is common throughout its range.

HABITAT AND ECOLOGY

Plants grow in semi-deciduous to evergreen notophyll or mesophyll vineforest, on a variety of substrates, but often on alluvium or near the sea. Young plants are common as pioneers in disturbed gaps or margins of the vineforest. The seed is a distinctive component of the drift flora of the Pacific (cf. Degener *et al.* 1978; Smith 1994).

The plant (and also *A. rockinghamensis*) is commonly known as 'Candle-Nut' and it is possible to use the fruits as a source of light by stringing them on wire and setting them alight.

NOTES

Aleurites moluccana may be distinguished from *A. rockinghamensis* on at least five morphological discontinuities (as given in the species key), as well as the seedling characters outlined in the species descriptions. It should be noted that the dimensions of seedling leaves and cotyledons may change with age and subsequent development; however, the basic differences of shape and venation remain the same.

REPRESENTATIVE SPECIMENS

IRIAN JAYA: Warnapi, 15 km N of Ransiki, Sep. 1948, *Kostermans 425* (BRI); Sorong, behind Kp. Baroc, July 1948, *Pleyte 454* (BRI); Kcbar Valley, Oct. 1958, *Schram BW7709* (CANB).

PAPUA NEW GUINEA: Madang Province: near Gurumbu Village, SW foothills of Finisterre Mtns, Aug. 1955, *Hoogland 5140* (BRI, CANB). New Britain Province: NE ridge of Mt Penak, N of S.D.A. Mission, Talasea, May 1968, *Frodin NGF26729* (BRI). Western Province: Lower Fly river, east bank opp. Sturt Island, Oct. 1936, *Brass 7997* (BRI, CANB). Northern Province: Kokoda Trail, July 1964, *Millar NGF23573* (BRI). Central Province: Kaota, Rona, Laloki River, Mar. 1933, *Brass 3644* (BRI). Milne Bay Province: Fife Bay, Sep. 1930, *Turner [AQ201270]* (BRI).

QUEENSLAND: Cook District: Elliott Falls, Jardine River, Oct. 1989, *O'Reilly 560* (BRI); Claudie River, Oct. 1972, *Dockrill 533* (BRI, QRS); Chester River Scrub, eastern fall of McIlwraith Range, June 1992, *Forster 10439 et al.* (BRI, QRS); Near T.R. 9, Lankelly to Pandanus Creek, Sep. 1971, *Hyland 5406* (BRI, QRS); Rocky River, Sep. 1971, *Hyland 5513* (BRI, QRS); Rocky River Scrub, Silver Plains, July 1993, *Forster 13622 et al.* (BRI); T.R. 176, Shipton L.A., Aug. 1982, *Hyland 11923* (QRS); S.F.R. 144 Windsor Tableland, Oct. 1971, *Hyland 5577* (BRI, QRS); S.F.R. 144, Whypalla, Chowchilla L.A., Dec. 1987, *Hyland 13474* (QRS). North Kennedy District: Daydream Island, Whitsunday Region, Apr. 1990, *Batianoff 900431* (BRI).

2. *Aleurites rockinghamensis* (Baill.) P.L.Forst. *comb. et stat. nov.*

Aleurites moluccana var. *rockinghamensis* Baill., *Adansonia* 6: 297 (1866), basionym.
TYPE: Queensland, Cook District: Rockingham's Bay [*Dallachy*]. LECTOTYPE: (**here designated**): MEL232486. LECTOPARATYPES: MEL232495, 232496, 232497, 232498.
Aleurites moluccana var. *floccosa* Airy Shaw, *Kew Bull.* 20: 26 (1966). TYPE: Papua New Guinea, Morobe Province: Wau, 28 June 1962, *J.J. Havel NGF9169* (HOLOTYPE: K, *n.v.* ISOTYPES: BRI, QRS).

Illustration: Christophel & Hyland (1993: 97, plate 35a).

Large spreading tree to 30 m high; trunk straight and without fluting or buttressing. *Bark* smooth, grey, nondescript; blaze brown speckled to cream. *Young shoots* with

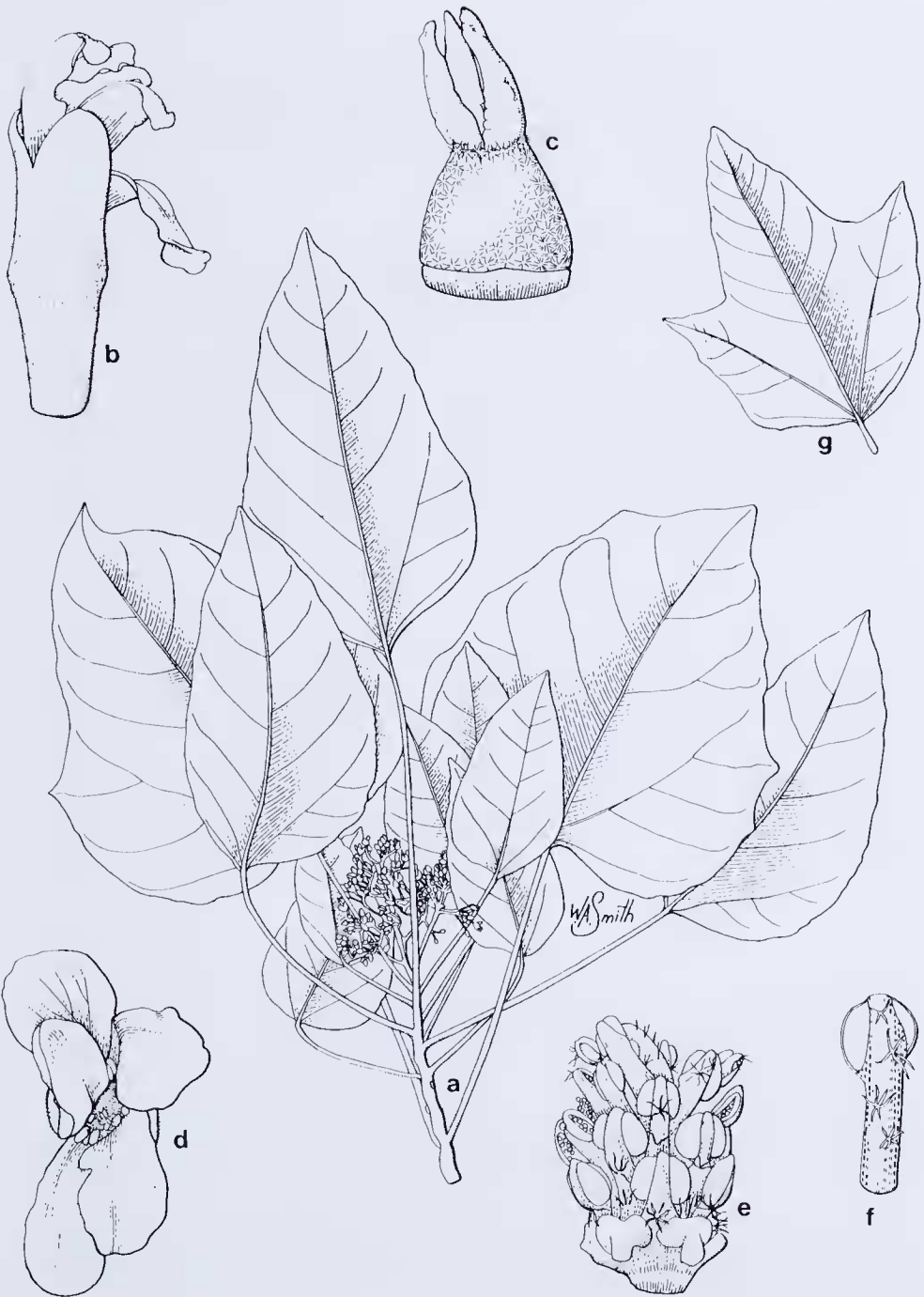


Fig. 1. *Aleurites moluccana*. a - flowering branch tip x0.4. b - gynostegium x10. c - lateral view of female flower x5. d - face view of male flower x5. e - lateral view of staminal mass x10. f - stamen showing stellate hairs x15. g - juvenile leaf showing lobing x0.4. a from *G.N. Batianoff 900431* (BRI); b, c from *B. Hyland 7809* (QRS); d-f from *B. Hyland RFK25167* (QRS); g from *M.O'Reilly 560* (BRI). Del. W. Smith.

dense, short, ferruginous-silver, stellate hairs. *Stipules* cylindrical, c. 1 mm long, with dense short, ferruginous-silver, stellate hairs. *Petioles* 30-210 mm long, 3-6 mm diameter, with dense, short, ferruginous-silver, stellate hairs. Leaf laminas entire or 3-lobed, ovate, ovate-lanceolate or ovate-trullate, 110-400 mm long, 70-300 mm wide, 3 or 5-veined from base and with 6-8 major lateral veins per side of midrib; upper surface glossy green, with dense, short, ferruginous-silver, stellate hairs, becoming restricted to the veins with age; lower surface pale green, with sparse to dense, ferruginous-silver, stellate hairs when young, often becoming restricted to the veins with age but often remaining velutinous; apex acute to acuminate; base cuneate. Inflorescence conical, 10-300 mm long and wide; axis with dense, short, ferruginous-silver, stellate hairs. *Male flowers* 10-12 mm long, 10-12 mm diameter; pedicels filiform, 5-15 mm long, c. 1 mm diameter, with dense, short, ferruginous-silver, stellate hairs; buds ovoid, 3.5-4.5 mm long, 3.5-4 mm diameter; calyx 2 or rarely 3-parted, halves often unequal, lanceolate to ovate, 3-5.8 mm long, 3-4 mm wide, with dense, short, ferruginous-silver, stellate hairs; petals oblanceolate to spatulate, 5.5-10 mm long, 2-4 mm wide, white to cream, externally glabrous, internally with longitudinal strip of dense, simple hairs; stamens 24-32; filaments 0.8-1 mm long, with scattered simple hairs; anthers 0.5-0.9 mm long, 0.3-0.7 mm wide, with scattered, simple hairs; disc lobes convolute. *Female flowers* 8-10 mm long, 10-12 mm diameter; pedicels stout, 2-3 mm long, 1-2 mm diameter, with dense, short, ferruginous-silver, stellate hairs; buds ellipsoid, 4.5-6 mm long, 3-3.5 mm diameter; calyx with 2 or 3 unequal lobes, each lobe 4-7 mm long, 3-4.5 mm wide, lanceolate to ovate, with dense, short, ferruginous-silver, stellate hairs; petals oblanceolate to spatulate, 9-12 mm long, 3-4 mm wide, white to cream, internally glabrous, externally with a longitudinal band of dense, simple hairs in the middle; ovaries 3-4-celled, subglobose, c. 2 mm long and 2.5 mm diameter, with dense, yellow, simple or rarely stellate hairs; styles 2.8-3 mm long, with sparse, simple hairs; disc glands small and rounded. *Fruit* ovoid-subglobose, 50-65 mm long, 70-80 mm diameter, with sparse ferruginous-silver, stellate hairs. *Seed* globose, 20-25 mm long, 20-25 mm diameter, dark brown. *Seedlings* at third leaf stage (voucher: Irvine 477 (QRS)); cotyledons broadly ovate-obovate, 95-100 mm long, 67-70 mm wide, weakly 5-veined from base, basal glands obvious; first seedling leaf trilobed with the median lobe acute; later leaves becoming entire. (Fig. 2)

DISTRIBUTION AND CONSERVATION STATUS

Aleurites rockinghamensis occurs in Australia and Papua New Guinea. In Australia it is largely restricted to the 'Wet Tropics' region of north-east Queensland, apart from a disjunct southerly occurrence near Ingham. In Papua New Guinea it has been recorded from lower montane parts of Morobe and Central Provinces.

Aleurites rockinghamensis is widespread and common in its known range.

HABITAT AND ECOLOGY

Plants grow in evergreen notophyll to mesophyll vineforests on a variety of substrates usually of volcanic origin. The species is a widespread pioneer and seedlings are common in gaps and margins of the forest.

NOTES

There are six sheets present in MEL that probably represent type material of the name *A. moluccana* var. *rockinghamensis*. None of them has a collector listed, although the 'Rockingham('s) Bay' labels are typical of those accompanying specimens collected by Dallachy and it seems reasonable to assume that he was indeed the collector. As lectotype I have selected one of the flowering portions that is also accompanied by nine lines of latin text. Some of the lectoparatypes are fertile, but most are leaves only. Specimens of *Aleurites* are difficult to fit onto a standard herbarium sheet and it is probable that the original collection has been split up in the mounting process.

Airy Shaw (1981) tentatively referred *A. moluccana* var. *floccosa* Airy Shaw to synonymy under *A. moluccana* var. *rockinghamensis*. The Papua New Guinean

specimens identified as *A. moluccana* var. *floccosa*, including the type, when compared with Australian material of *A. rockinghamensis*, often have male flowers with generally longer pedicels, and more noticeably velutinous lower surfaces of the leaves. The leaf indumentum cover is not consistent on all specimens and as there are no other differences, this later variety is reduced to synonymy.

REPRESENTATIVE SPECIMENS

PAPUA NEW GUINEA: Morobe Province: Crooked Creek, Bulolo, June 1962, *Havel & Henry NGF9163* (BRI); Watut Divide, Bulolo, Oct. 1969, *Streimann NGF44233* (CANB); Upper Watut, Feb. 1971, *Streimann & Kairo NGF44575* (BRI, CANB); Kauli Creek, Wau, Mar. 1962, *Millar NGF14503* (BRI, CANB); Edie Creek road, above Wau, May 1963, *van Royen NGF16311* (BRI, CANB); Sopa, June 1962, *Hartley 10342* (BRI, CANB); Boana, Apr. 1938, *Clemens 8119* (CANB). Central Province: On ridge below Boridi Village, Oct. 1973, *Foreman & Vinas LAE60238* (BRI).

QUEENSLAND: Cook District: c. 6 miles [10 km] NW of Daintree on bank of Daintree River, Nov. 1967, *Boylard 516 & Gillieatt* (BRI); Porn. 188 Alexandra, Hutchinson Creek, *Hyland 6726* (BRI, CANB, QRS); Rex Range, Little Mossman L.A., S.F. 141, Jan. 1993, *Forster 13073 & Bean* (BRI, L, MEL, QRS); Kuranda Range road, Mar. 1987, *Godwin C3034* (BRI); Mowbray River, Jan. 1932, *Brass 1991* (BRI); S.F.R. 933, Feb. 1975, *Hyland 8014* (BRI, CANB, QRS); S.F. 185 Danbulla, 1.5 km SW of Hoop Pine Triangle, Jan. 1993, *Forster 13080 & Bean* (BRI, MEL, QRS); S.F.R. 185, Nursery L.A., Dec. 1971, *Hyland 5737* (BRI, QRS); S.F.R. 194, on the Dividing Range near Oaky Creek, Jan. 1972, *Hyland 5749* (BRI, QRS); Tolga Scrub, Mar. 1973, *Irvine 477* (BRI, QRS); Near Barron River on Atherton to Yungaburra road, Mar. 1971, *Stocker 613* (BRI, QRS); Lake Eacham, Atherton Tableland, Aug. 1929, *Kajewski 1180* (BRI). North Kennedy District: S.F. 268, June 1994, *Forster 15640* (BRI, K, L, MEL, NSW, QRS).

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Fig. 2. *Aleurites rockinghamensis*. a - flowering branch tip x0.5. b - lateral view of female flower x4. c - face view of female flower x4. d - lateral view of gynostegium x8. e - face view of male flower x4. f - lateral view of staminal mass x8. g - stamen showing simple hairs x16. h - lateral view of fruit x0.4. i - cross-section of fruit showing 4 seeds x0.4. a-d from *P.I.Forster 13073 & A.R.Bean* (BRI); e-h from *P.I.Forster 13080 & A.R.Bean* (BRI); i from *W.Birch 55* (BRI). Del. W. Smith.

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